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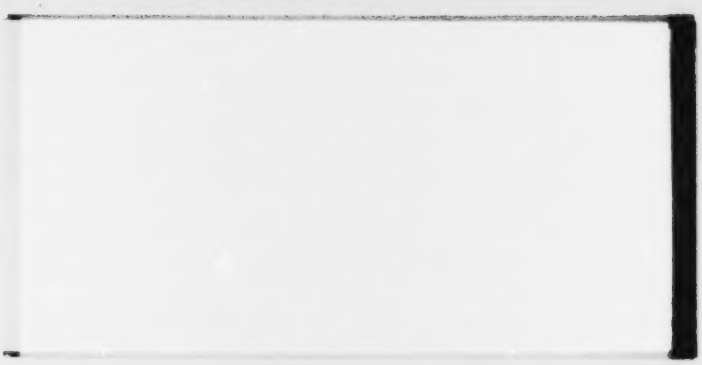
Ontario



TECHNICAL SERVICES DIVISION
RESEARCH & DEVELOPMENT SECTION

TOWARDS MORE COMPREHENSIVE WATER MANAGEMENT: A CASE STUDY OF THE REGIONAL MUNICIPALITY OF WATERLOO, ONTARIO, CANADA

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for

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Research and Development Section

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Acknowledgements

The issue of non-structural municipal water supply alternatives has yet to receive substantial recognition in Canada.

Indisputably the quality of the water we consume is an important concern. Of at least equal importance however, is the quantity (supply) of this resource that is available for our utilization.

The Waterloo Water Conservation Program is the most intensive Canadian effort currently examining non-structural supply management as a means of curtailing the requirement for municipal water. It is intended that through such effort additional time will be provided so that administrators may identify and implement efficient long term supply strategies.

The proponents of the Waterloo Program are very appreciative of the funding received from various agencies thus far. However, funding for non-structural supply oriented projects is limited to say the least! It is for this reason that the authors very gratefully acknowledge the Ministry of Municipal Affairs, Technical Services Division (Research and Development Section), for sponsoring this report. It is only through opportunities such as this that awareness and support for potential non-structural alternatives to water supply can be encouraged. We would specifically like to thank Robert Marshall, the Ministry's

Research and Development Officer, our initial contact, and especially Andrew Zdanowicz, the Ministry's Manager of Research and Development, for inspiring this report. We would also like to thank Jean Webster who typed the bulk of the text, and Gary Brannon of the university's cartography office who prepared the illustrative material.

- Waterloo, Ontario
March, 1983.

EXECUTIVE SUMMARY

The Regional Municipality of Waterloo is the largest metropolitan area in Canada that relies primarily on groundwater for its municipal water supply; for this reason it is appropriate that an intensive water conservation program should have been implemented to use this finite resource as effectively as possible. The program has been designed to take a 'total systems approach' to water management in this area. Consequently topics such as Information/Education, Incentives for Water-Efficient Construction, Residential Retrofitting, Pricing, Inflow/Infiltration, and Water Pressure Reduction have been actively pursued by program staff under the direction of the Municipal Working Group on Water Conservation Alternatives. The projects have been assessed in terms of 'constraints' - institutional, financial, administrative/political, and technical.

The objectives are to document the success of the programme, to identify other areas requiring investigation, and to provide some guidance to other municipalities.

Finally, the conclusions of this report stress the benefits of this Program as a multi-faceted approach to water conservation.

INTRODUCTION

The Regional Municipality of Waterloo was formed in 1973, and consists of three cities: Cambridge, Kitchener, and Waterloo, and four rural townships. This Region is the largest metropolitan area (population approximately 300,000) in Canada still able to use groundwater, that essentially needs no chlorination, as its primary source of water supply (Figure 1 and Figure 2). The supply system for each city was mainly located in adjoining rural townships, and therefore the responsibility for water supply was transferred from the local municipalities to the Regional Municipality of Waterloo at the inception of regional government. The responsibility for water distribution and retail price structures remains with the local municipality.

In response to increasing urban demand for water, the region has continued to drill more wells. Presently there are 90 such wells in the Regional Municipality of Waterloo. Prior to 1980 there was a perceived substantial lowering of rural water tables. At least two related reasons have been determined for this perception:

1. Increasing urbanization reduces the natural rate of groundwater recharge both by increasing the rate of runoff and by covering over the recharge areas, and;
2. Increasing populations with increasing per capita water use are resulting in increased rates of groundwater withdrawal.

In the 1970's, this resulted in a major conflict between the urban and rural areas as a number of wells, ponds, and streams dried up. Although a groundwater hydrologist asserted that the Regional wells were too far from the affected farms for the drawdown cone

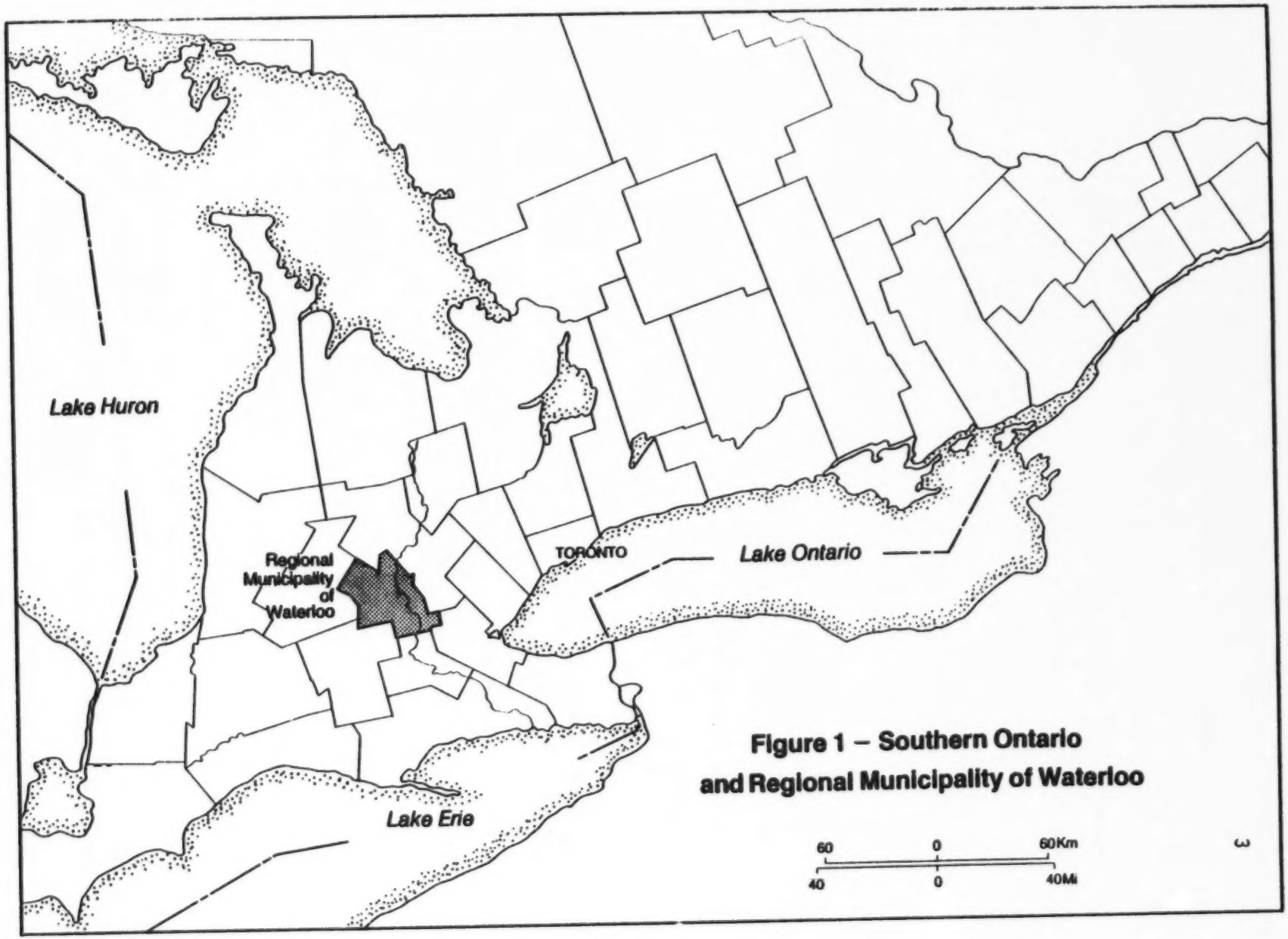


Figure 1 – Southern Ontario and Regional Municipality of Waterloo

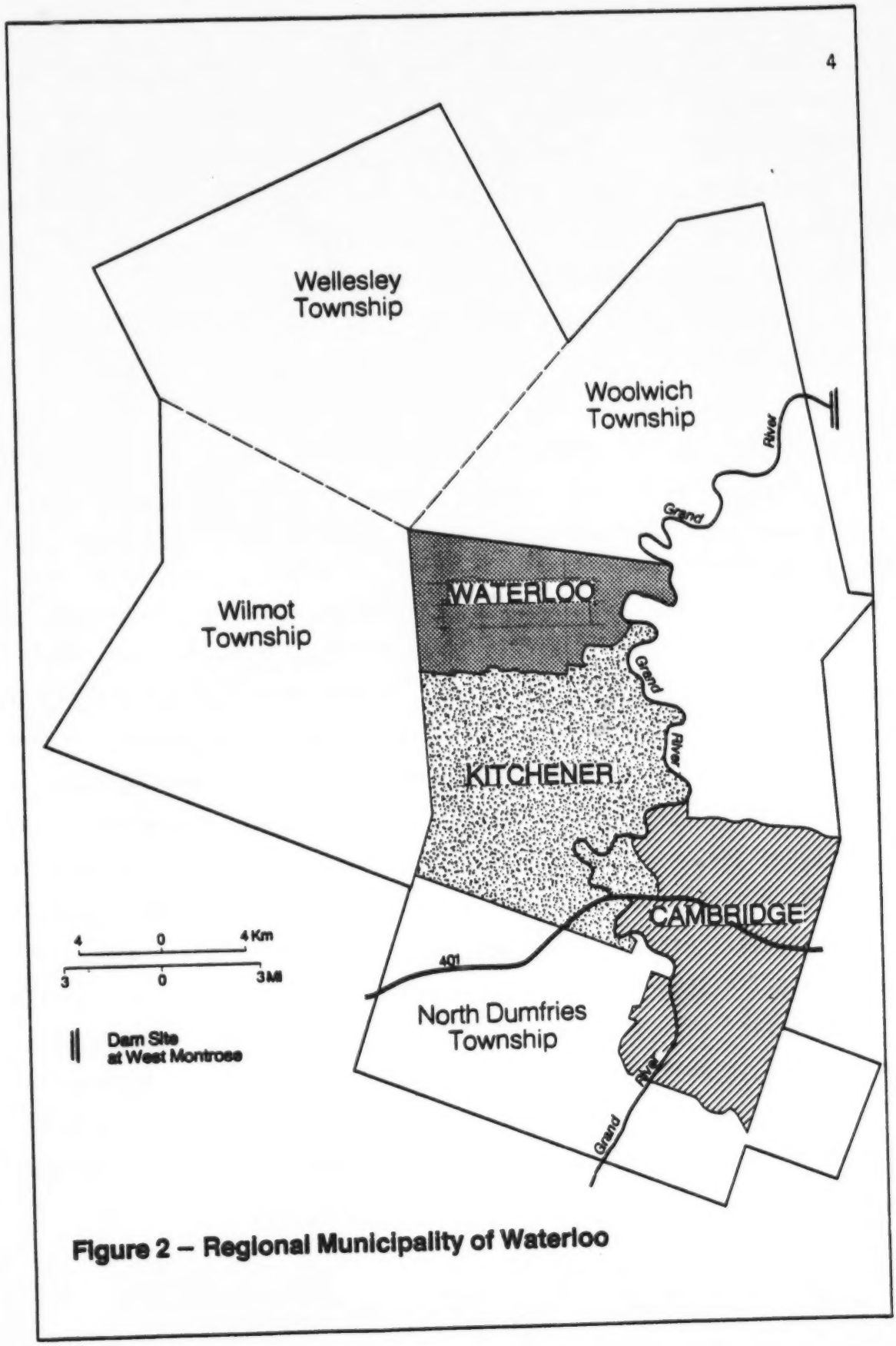


Figure 2 – Regional Municipality of Waterloo

to be significant, the rural residents felt otherwise. The farm community in one township (Wilmot) became adamant that no more wells should be drilled and that other supply options should be developed and used, especially when the cities do not take stewardship of this resource seriously. The result of the conflict was an agreement by the Regional Municipality of Waterloo not to increase annual water takings from the rural townships beyond the historical maximum quantity withdrawn in 1978. As a result, then, it became inconsequential whether or not water withdrawals by the Regional Municipality of Waterloo really were causing the water tables to be lowered. The political decision was made that any additional water supplies would come from other sources.

In November, 1977, it was reported by the Chairman of the Regional Council that water supplies for Cambridge in particular are not proven beyond 1988, and that even with augmentation from the Kitchener-Waterloo system, an additional supply would be needed by 1996 at the very latest. At that time, the major supply alternatives considered were the construction of a dam on the Grand River (the principal river in the area) combined with induced infiltration and/or artificial recharge. Such a proposal created implications for externalized social and economic disruption i.e. dislocation of families and flooding of good farmland in areas which would in no way benefit from this capital project. Beyond this dam proposal there was the option of a far more expensive pipeline to Lake Erie. Other alternatives included

induced infiltration wells which are now being used on a regular basis to withdraw water from the Grand River, and artificial recharge of an aquifer with river water at high flows so it can be discharged at low flows, which has shown very promising results. However, cost estimates, related to water supply, for the dam and the pipeline were $17 million (1976 costs) and approximately $230 million respectively.

THE PROGRAM

In January, 1978, a group of faculty and students in the Department of Man-Environment Studies at the University of Waterloo began research on the feasibility of a comprehensive water conservation program as an alternative which might reduce the need for expensive new water supply projects, and improve management of the existing resource. The initial results appeared sufficiently promising that financial support was provided by the Region, and the two senior levels of government, with cooperation from the three major constituent municipalities. (Cambridge, Kitchener and Waterloo) The funding was provided principally for the purpose of developing and disseminating water conservation information both for schools and householders, as education was considered a high priority by local and regional politicians.

1. Information/Education

Public information and community communication along with development of personal commitment are the keys to a successful conservation program. (Paul,1976) The importance of education can be further recognized by noting that up to a 10 percent reduction in water demand can be achieved by education alone, making it one of the most effective approaches for small reductions.

In Waterloo, the prior Regional effort consisted principally of a series of summer newspaper notices regarding lawn watering restrictions as well as the occasional distribution of brochures describing ways and means of conserving water in the home. Due to an apparent lack of public understanding of both the water supply system and approaches to conservation, a broader program was undertaken. The following program targets (actors) were selected for initial emphasis: adults, children, large water users, and municipal politicians.

In the adult part of this program, two public education centres were created with the purpose of testing a large number of approaches to public education. The development of shopping mall displays, water bill stuffers and messages used by local utilities, radio public service commercials, and a conservation information package were undertaken. Two slide-tape programs on the water supply system and on water conservation were developed for general use. A media water supply status alert to keep the public posted daily on water demand was implemented during the

summer of 1979. All these efforts were seen to have a dual function: to educate the public as well as to test the feasibility of various information approaches. With regard to children, classroom talks were given in schools in the three cities. As well, the slide-tape presentations were also requested by the Board of Education for adaptation to use in elementary schools. A manual on water conservation and re-use was developed for distribution to local industries and other large water users. Audio-visual presentations on conservation were made to local politicians as work was completed. In addition, the information/education work focussed on a study of social and non-profit marketing literature for proven and theoretical approaches to conveying the concept of conservation. (Holland, 1979)

2. Unmatched Jurisdictional Responsibilities and Benefits

However, by the fall of 1979, the funding for the project from the Regional Municipality of Waterloo was withdrawn. The principal reason was that all water conservation recommendations, especially those going beyond education, might benefit the Region substantially, but they required implementation by other levels of government and not by the Region. This problem is a result of the division of jurisdiction of the water management process among different levels of government.

The highest level of government directly involved is the Province of Ontario, which operates the wastewater treatment plants. As was mentioned earlier, the Regional Municipality of

Waterloo is the water supply agency, and the local municipalities are the water distribution agencies (Figure 3). Another level which must be considered is that of the water customers, who are the source of demand.

In summary, municipal water management is carried out by at least four different levels, each responsible for different parts of the management process. Most of the water demand management measures that were recommended had to be implemented by the local municipalities, which have regularized contact with customers, and could have influence over demand. The Regional Municipality of Waterloo in effect only wholesales water to the local municipalities, so it felt that without some agreement on the part of the local municipalities to proceed, there was little point in continuing funding.

3. The Municipal Working Group on Water Conservation Alternatives

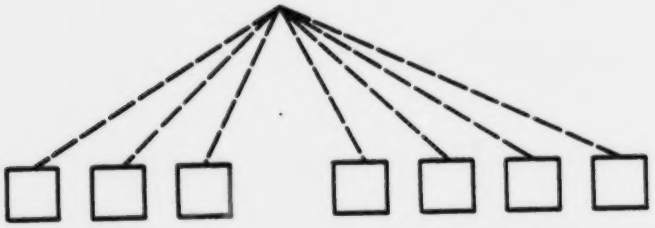
The individual municipalities were then approached and agreed to form a Working Group on Water Conservation Alternatives at the end of 1979. This group consisted of mayors (or designates) of the three cities and two interested townships, and a senior water staff person from each of the three cities and the Region (Figure 4). The Working Group was funded by the Region on the understanding that the local municipalities would proceed to implement recommendations considered feasible. The Working Group began by setting a number of priorities in their concern about influencing the demand for water.

PROVINCE OF ONTARIO

– operates wastewater treatment plants

REGIONAL MUNICIPALITY OF WATERLOO

– water supply agency



LOCAL MUNICIPALITIES

– water distribution agencies

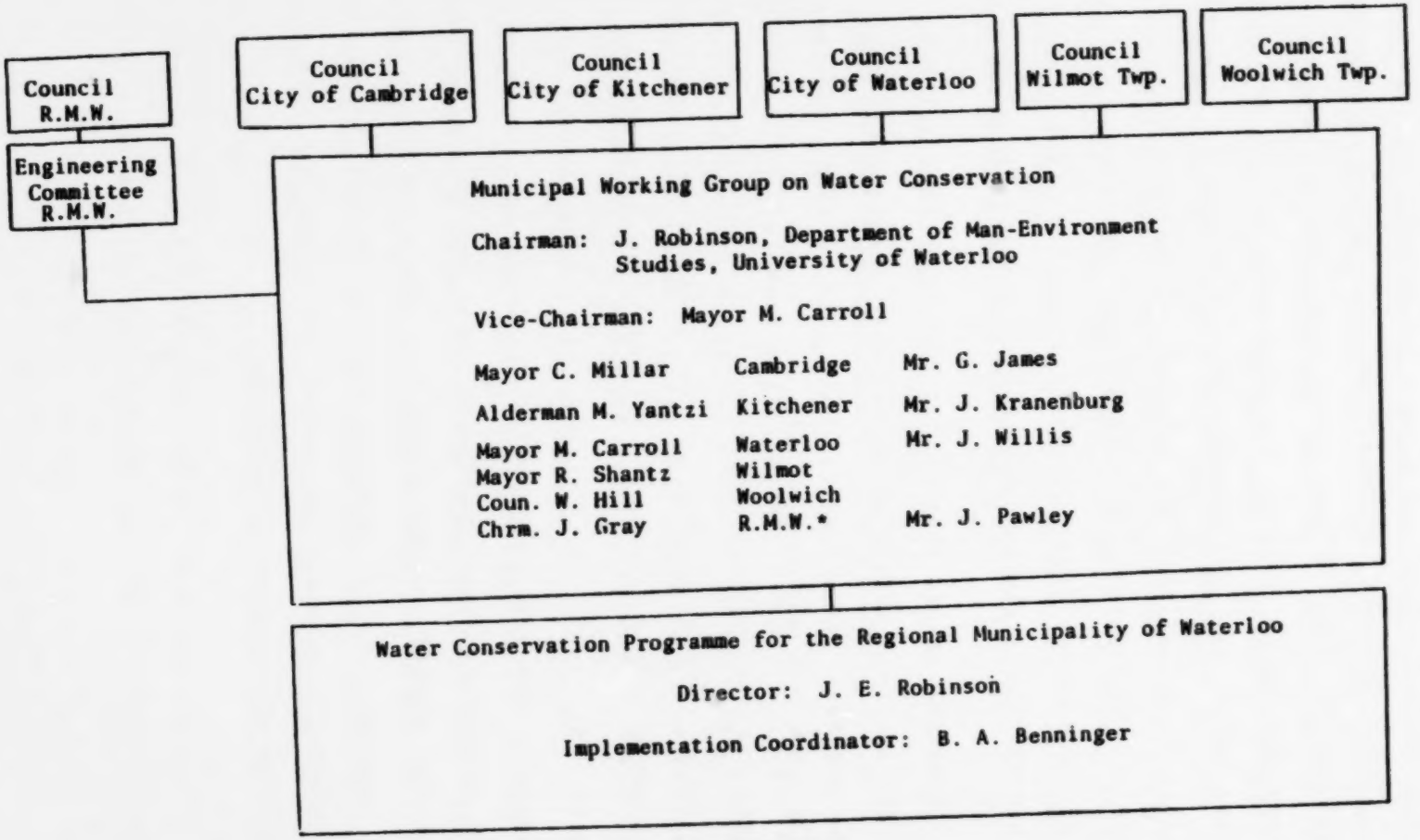
WATER CUSTOMERS

– water users, sources of demand

Figure 3 – Municipal Water Management Levels

Figure 4: MUNICIPAL WORKING GROUP ON WATER CONSERVATION

ORGANIZATION


Council R.M.W.
Engineering Committee R.M.W.
Council City of Cambridge
Council City of Kitchener
Council City of Waterloo
Council Wilmot Twp.
Council Woolwich Twp.
Municipal Working Group on Water Conservation
Chairman: J. Robinson, Department of Man-Environment Studies, University of Waterloo
Vice-Chairman: Mayor M. Carroll
Mayor C. Millar Cambridge Mr. G. James
Alderman M. Yantzi Kitchener Mr. J. Kranenburg
Mayor M. Carroll Waterloo Mr. J. Willis
Mayor R. Shantz Wilmot
Coun. W. Hill Woolwich
Chrm. J. Gray R.M.W.* Mr. J. Pawley
Water Conservation Programme for the Regional Municipality of Waterloo
Director: J. E. Robinson
Implementation Coordinator: B. A. Benninger

* Regional Municipality of Waterloo

A. Regulations for New Structures

Their highest priority was to reduce consumption in new structures, i.e. to make water efficiency standard practice in new construction. However, building construction and its regulations come under the jurisdiction of the Province. In Ontario, the local municipalities are required to enforce building regulations for new construction and since such regulations are determined at the provincial level the municipality's feel that they cannot require that fixtures installed in a building be water-efficient.

Research showed that all of the major manufacturers of plumbing fixtures have models which require considerably less water than the standard models sold, and with a very low marginal cost. ($0.-$5.) Toilets are a prime example: the current standard toilet may use up to five to seven gallons per flush, whereas toilets are available which use no more than 2.8 Imperial gallons per flush. However, these models are only manufactured in simple white, so there is little scope for upgrading sales on those models. The cost differential is primarily one which compensates for relatively lower production runs and special ordering as they are not always stocked except in areas where they are required. In summary, it is apparent that it is now technologically and economically possible to reduce the demand for water by changing the type of fixtures in buildings.

Jurisdiction lies with the Province under Section 48 and Regulation 736 of the Ontario Water Resources Control Act.

However, the Province administers that Section (48) not through the Ministry of the Environment, which has some interest in water and which administers the remainder of the Act, but through the Ministry of Municipal Affairs and Housing, whose mandate is to enforce these regulations. The Ministry of Municipal Affairs and Housing updates the regulations through a consultive process. In light of this process it can be appreciated that any changes to the regulations will take some time. Thus, it became apparent that requiring water efficiency as standard practice in new building construction was not going to happen overnight.

B. Incentives for Water-Efficient Construction

The next approach was to try to achieve the same end without requiring it. A series of options were considered and the one recommended as most workable was to give a rebate to builders. Some of the analysis estimates for this option are presented in Table 1.

The Regional Municipality of Waterloo agreed in principle to give a $75.00 rebate to builders for each dwelling unit which was constructed using fixtures designed to meet specific regulations on flush volumes and flow rates at a specified pressure. What this means, for example, is that a toilet with bottles in the tank would not be eligible; eligible fixtures would not be easy to convert back to water consuming fixtures.

Table 1.0: Cost Effectiveness of Alternatives to Standard Household Fixtures

Standard 4 imp. gal. toilet	90.00	20	5,840 3.68		
Standard 8 imp. gpm shower head	10.00	10	11,680 (5,840 heated)		
Alternative Fixture (Toilets)	**Cost (1980)**	**Life of fixture**	**Savings g/yr/cap $/yr/cap**	**Total Cost over 20 yr. period**	**Total Savings @ 5% /capita /family (4)**
Water Saving Toilet(2.4 imp g/flush	20.00	20	2,336 1.47	20.00	16.30 (73.30)
Water Saver Toilet(1.0 imp g/flush)	190.00	20	4,380 2.80	190.00	35.00 (140.00)
Composting Toilets(0.0 imp g/flush)	620.00	20	5,840 3.68	620.00	46.00 (184.00)

Alternative Fixture (Showers)	**Cost**	**Life**	**Savings**	**Total Cost**	**Total Savings**
Nova(2.0 imp gpm @ 50psi)	9.96	10	2,920 - 1.84 1,460 -12.75 (e) 6.10 (g)	9.96	14.20 (water) 98.00 (elect) 48.00 (gas)
Shower Saver 2.1 gpm	2.25	10	2,482 - 1.56 10.83 (e) 5.18 (g)	2.25	12.04 (water) 83.62 (elect) 40.00 (gas)

The rebate programme is still pending until a simple system of identification of such fixtures can be developed for the plumbing inspectors. To this end, meetings were held with the Canadian Standards Association (CSA) the Plumbing Industry Advisory Committee, and the Advisory Council on Plumbing. A number of concerns of plumbing manufacturers were addressed including the legitimacy of incentive programmes to stimulate change in product sales, and the questionable desirability of cataloguing, labelling, and certification of such fixtures. Liaison among these groups is continuing slowly.

In the interim, a meeting was held with officials of three major toilet manufacturers (American Standard, Crane, and Eastern Potteries) in February 1982 in the presence of CSA personnel. Publication of specific information about fixtures was felt to be unnecessary at the time. However, there was agreement that toilets advertised as being 'water-saving' could be tested by CSA and certified on a CSA label as being water-saving, i.e. meeting a standard such as using less than 2.8 imperial gallons per flush. This agreement was to be discussed at the June 8, 1982 meeting of the CSA B45 Committee which discusses changes to toilet standards. However, it was not on the agenda, and thus not discussed. Perhaps the next B45 Committee will address the issues.

C. Water Conservation Management Information

The second priority of the Working Group was to continue water conservation education on a broad level. A number of conservation education programmes were described earlier. The water use index, devised by the Region's Director of Water Supply, has been continued each year in the months of June, July, and August in the daily newspaper, with some relatively minor revisions resulting from an evaluation of the index.

Another project has been to insert water conservation newsletters in municipal water bills twice each year to give information both on the conservation programme and on water management tips. To date approximately 135,000 newsletters (two different publications) have been distributed twice yearly.

A third education project has been an attempt to integrate water conservation units in elementary school curricula. A fully annotated bibliography of resource material for a teaching unit has been developed in conjunction with environmental studies consultants in the Waterloo County Board of Education.

Education of civil servants at many levels of government has been carried out. For example, a half-day seminar/discussion was led on Alternatives to Capital Intensive Water and Sewage Projects. This was sponsored by the Project Planning Branch of the Ontario Ministry of the Environment in November 1981. In addition, the work of the Water Conservation Programme was presented to a seminar at the November conference on Building Toward 2001 sponsored by the Ontario Ministry of Municipal Affairs

and Housing, at the June 1982 Water Symposium held in Calgary, and at the American Water Resources Conference in San Francisco, October 1982.

D. Residential Retrofit of Water Saving Devices

The third priority set by the working group in 1980 was to investigate futher the desirability of retrofitting existing structures with water saving devices to reduce water demand. A pilot study carried out the previous year had noted promising results.

(a) Pilot Project

Reducing overall demand in the residential sector by means of a retrofit program for toilets and showers had not previously been tested in detail. The items distributed consisted of one of the most effective, reasonably priced water saving devices for toilets (the Aqua-Saver), and showers (a flow restrictor), leak detection tablets, and a conservation information calendar; the 'bucket kit' cost approximately $4.23. This study involved ten weekly meter readings and pre- and post-test interviews with residents in 202 homes. The purpose was to test:

I. the relative cost-effectivenss of installing the devices using trained personnel versus just delivering them to the home;

II. the actual water savings over the short term duration of the study; and

III. the public acceptability of each of the devices which might be used in a large scale program and of the retrofit program as a whole.

No significant water savings were found in the group simply given the kit. These results are not inconsistent with literature indicating very small savings e.g. 3%. However, water consumption in the installed households was reduced approximately 20% over the ten week period, compared with their consumption over the previous two years.

The most cost-effective method of distributing this kit appears to be to install the devices using trained personnel. (Difficulty in properly adjusting the Aqua-Saver device in some toilets appeared to present the main problem to untrained people.) These observations were made despite the fact that public acceptance of both the toilet and shower devices, i.e. leaving both devices installed or installing both devices, was only 55 percent.

At the same time, a longitudinal study of the longer term water consumption effects of installation of the toilet "Aqua-Saver" device was undertaken by following up on a pilot installation project which had been carried out by the manufacturer in 100 homes about three years previously. A similar acceptance rate (i.e.non-removal rate, 64 percent) of the Aqua-Saver alone was found in this study after almost three years, as was found for the

kit in the above program after 10 weeks. As well, the longer term water demand reduction was about 12 percent for the Aqua-Saver alone, compared with 20 percent for the entire kit in the short term duration of the study.

It should be noted that after this period of time, based on observations, the Aqua-Saver was still very effective in many toilets. Water consumption was reduced by more than 30 percent in 57 percent (91) of the toilets (or approximately 50 percent in 45 percent of the toilets). Median savings for toilet water consumption would thus be about 40% based on visual observation.

Factors which resulted in unsatisfactory installation of an Aqua-Saver in a particular toilet (about 35-50 percent of the toilet population)were investigated to ascertain whether these factors can be identified prior to installation. If such toilets can be identified, William Sharpe (1978) has reported that of the many other types of toilet devices for which he has collected data (not including the "Aqua-Saver", a Canadian device) "it would appear...that plastic bottles are the most suitable device for mass retrofit water conservation programs." The reasons include lower cost, great durability, and ease of installation and adjustment (i.e. removing or changing size). As well, in one study, all of those homes receiving displacement bottles still had them installed four years later. If bottles can work satisfactorily in these toilets, criteria must be determined to predict whether an Aqua-Saver or a set of bottles will be more

effective in reducing water demand in a particular toilet. One obvious criterion is the volume of bottles which can be used. Although the mass retrofit programs in the United States using bottles as a water-saving device, have generally only used two quarts (U.S.) per toilet, Sharpe has 'bench-tested' toilet displacements of one Canadian gallon (five U.S. quarts). These displacements are somewhat less than an Aqua-Saver in a suitable toilet, but very good especially for toilets in which Aqua-Savers do not function properly.

(b)Retrofit Demonstration Project 1981

Following up the previous work, a cost-benefit analysis was done (Table 2). A retrofit demonstration project was approved for 1981, with funding to come jointly from the federal and regional governments.

The Freeport area in the south-east corner of Kitchener was selected as the pilot project test-site. The neighbourhood is geographically depressed so all waste water is pumped up into the city trunk sewers through one pumping station. This allows monitoring of wastewater savings to be conducted on a gross scale complimenting the house-by-house monitoring made possible through individually authorized access to account numbers. Approximately 80 per cent of the people personally contacted in Freeport allowed the Installers to enter their homes and install water-saving devices (mechanical devices where feasible, or displacement bottles) in their water closet and flow restrictors in their

CITY OF WATERLOO

	Base Projection A. No Retrofit Programme		B. Immediate Retrofit Programme		C. Future Retrofit Programme	
	STP: 2001 (1980 $)		STP: 2005, RF: 1980, WS: 1982		STP: 2005, RF: 1999, WS: 2001	
	Costs	Benefits	Costs	Benefits	Costs	Benefits
Sewage Treatment Plant Expansion	[$4,100,000]	$	$	$259,000	$	$ 259,000
Retrofit Programme Costs	--					
and						
Water Supply Savings: Capital		--	62,374	92,467	41,200	59,600
Maintenance		--	21,656	12,800	13,517	8,248
Energy		--	2,970	120,000	1,283	77,380
Totals	0	$ --	$ 87,000	$514,267	$ 56,000	$ 404,226
				$427,000		348,000
NET BENEFIT	0					

CITY OF KITCHENER

	Base Projection A. No Retrofit Programme		B. Immediate Retrofit Programme	
			RF: 1980, WS: 1984	
	Costs	Benefits	Costs	Benefits
Sewage Treatment Plant Expansion	$ --	$	$ --	$ --
Retrofit Programme	--			
Water Supply Savings: Capital		--	170,987	230,000
Maintenance		--	59,438	31,830
Energy		--	6,575	273,000
Totals	$ --	$ --	$237,000	$578,000
				$341,000
NET BENEFIT	$ 0			

CITY OF KITCHENER: FREEPORT

	A. No Retrofit Programme		B. Immediate Retrofit Programme	
	STPu: 1982 (1980 $)		STPu: 1984, RF: 1980, WS: 1982	
	Costs	Benefits	Costs	Benefits
Sewage Pumping Station Expansion	[$295,500]	$	$	$ 25,000
Retrofit Programme	--			
Water Supply Savings: Capital		--	10,813	24,000
Maintenance		--	3,735	3,300
Energy		--	452	28,500
Totals	0	$ --	$ 15,000	$ 80,800
				$ 66,000
NET BENEFIT	0			

TABLE 2: EVALUATION OF IMPLEMENTATION OF A RESIDENTIAL RETROFIT PROGRAMME IN WATERLOO, KITCHENER, AND FREEPORT.

showers. Virtually every homeowner participating in the Retrofit Project agreed to answer a questionnaire which requested information varying from number of people dwelling in the house to the model and capacity of the water softener. This information has been collected but has not as yet been analyzed.

As well as the approximately 1,300 dwelling units installed with water-saving devices in Freeport, an additional 2500 apartment units throughout the Regional Municipality of Waterloo were also retrofitted. A preliminary estimate of reduction in water use, using quarterly consumption data collected by city meter readers, is 10%-12% for a sample of 10 apartment buildings, compared to previous years consumption.

E. Pricing

As well as reducing overall or average demand, reducing peak demand is clearly an even more direct and important approach to the water supply problems in the Regional Municipality of Waterloo, as the provision of peaking capacity is expensive and severely stretches the available water supply capabilities of the Regional equipment. A total ban on lawn watering was necessitated for several days in the summer of 1978 to maintain adequate fire-fighting capability.

The present water rate structures in two cities in the Region (Cambridge and Kitchener) are declining block-type structures. By making use of large volumes of water relatively much less

expensive than use of small volumes, the declining block structure does not reflect either increasing long run costs of producing water (e.g. for the relatively small amount of demand which necessitates construction of a major new supply source) or for any of the well-known expensive marginal costs of supplying peaking capacity (e.g. for lawn watering during hot dry periods in the summer). It has been estimated that the costs of providing water for peaking uses in the Region may range from $1.75 - $3.81/1000 imperial gallons when, in fact, the wholesale rate for water in the Region is $0.40/1000 gallons to May 1983. As well, from an equity standpoint, industries or householders with a relatively constant consumption year round should not have to provide costs associated with peaking uses. The declining block structure is currently in use partly because when it was derived, water supply was relatively unlimited, and because alternative structures which satisfied the generally accepted rate-making criteria (including equity to customers, cost recovery, and practicality) were untested.

However, in the past six years, a number of jurisdictions in North America have undertaken rate structure reviews, conducted by either utility staff alone or in conjunction with a citizens advisory committee. Combinations of a service charge, uniform commodity rates, excess summer charges, and increasing rate structures have been implemented to replace declining block structures as the most economical option in areas faced with large expenditures for new water supply. Examples include Fairfax

County, Virginia and the Maryland Counties served by the Washington Suburban Sanitary Commission.

As mentioned in the introduction, in the Regional Municipality of Waterloo one level of government (the Region) is responsible for water supply while another (the individual cities and townships) determines the retail rate structures. The continuing co-operation of each municipality in political decision-making and implementation of appropriate conserving rate structures is necessary to prevent a potential "tragedy of the commons". It is currently in no individual city's best interests to worry about peak demand, although collectively the impact could be very significant in reducing costs to the Region and indirectly to them.

A discussion paper has been prepared examining the effects and implications of implementing an excess use charge in the City of Kitchener. A proposed formula would substantially increase the water rate for any summer volume which exceeds by more than a factor of 1.25 the average winter consumption.

A preliminary study of the effect on residential and non-resident consumers of a surcharge on excessive summer water consumption was completed. Implementation of such a surcharge has been endorsed in principle by the Municipal Working Group on Water Conservation and discussion regarding political concern and responsibility for implementation costs have been initiated with the Regional Municipality and with the three cities. Based on the

initial correspondence, it appears as though the immediate inconvenience to staff administration in changing the billing structure may make it difficult to convince municipal and utility staff of the merits of an alternate mode of billing!

F. Inflow/Infiltration Into the Sewer System

Work was initiated on the feasibility of reducing wastewater treatment loading by eliminating foundation drainage connections to the sanitary sewer system, particularly in high water table areas. (Although establishing these connections is now illegal, it was often common practice in the past.) In one area two-thirds of the sanitary system appears to be carrying "clean" water despite complete separation of storm and sanitary sewers. Obviously much water is getting in which is unmetered; possible sources include weeping tile connections, and broken sewer mains beneath the water table.

A related area recently regulated as part of the subdivision approval process at the Regional level is a requirement for satisfactory stormwater detention facilities to reduce sewage treatment plant loadings and to increase the groundwater recharge capability. This can also be thought of as a demand management measure to reduce stormwater throughput.

G. Water Pressure Reduction

Study has been initiated on the feasibility of reducing water pressure in buildings in selected areas of the Regional

Municipality to reduce water demand as well as wear on fixtures. It has been determined that water is being supplied to a number of areas in Kitchener at a pressure in excess of 70 p.s.i. Such pressure can be both wasteful, as more water is delivered than is required, and destructive as premature wear and damage to the plumbing systems also results.

H. Water Management Planning

Comprehensive water management planning including urban water conservation has been rapidly evolving over the past few years in North America. One of the most direct stimuli came from President Carter's May 1977 Environmental Message to Congress: "We need comprehensive reform of water resources policy with conservation as its cornerstone." In the President's Water Policy presented in June 1978, federal agencies were directed to require explicit consideration of water conservation as a condition of federal assistance in water supply and wastewater treatment programs. This was administered by a set of Principles, Standards, and Procedures developed by the Water Resources Council.

The stated goal and policies of the Ontario Ministry of the Environment are "to ensure the fair sharing and conservation of ground water" (O.M.E. 1978). However, it has become apparent that the above statement need be more strongly pursued. For example; one area of exploration could be that conservation or explicit demand management alternatives be considered as a condition of funding assistance for water projects. It is also important that

groundwater recharge areas need to receive more attention; it can generally be concluded that the degree of paving allowed will portionally affect the extent of groundwater recharge in any given area.

COMMENTS

Despite the apparent potential of conservation measures, there are a number of inter-related issues that need to be addressed in order to achieve balanced water management planning. Although a few conservation efforts, such as lawn watering regulations and informal work with industries, had been implemented with some success by the Region prior to 1978, almost all effort was focussed instead on increasing supply. There are a number of lessons which can be learned from this experience.

CONSTRAINTS - GENERAL

1. Water has been an inexpensive commodity (approximately 40 cents per 1000 gallons) in the past and even the marginal cost of new supply has been quite low. Demand management should be considered.

2. Institutionally, the separation of the supply function from the distribution function gives the Region no direct contact with water users and effectively reduces it to a purchasing agent for the local municipalities. The cities, on the other

hand, have reason to be interested only in increasing supply as there is no incentive for their individual conservation of the groundwater resource which is held in common. Significant amounts of cooperation are needed.

3. The additional separation of the water supply function (Regional responsibility) from the wastewater treatment function (joint municipal-provincial responsibility) and the planning function (municipal-Regional) ensured that water conservation alternatives tended not to be considered in assessing the need for increased sewage treatment capacity. These throughput reduction options need to be considered, but inter-agency cooperation is again required.

4. Financially, while it does not appear to be a major concern in this case, conservation can be threatening to water department staff concerned with revenue stability, and its potential effect on jobs and ability to cover costs. The responses of planning for water conservation, and recognition that inflation may be a greater threat to revenue stability than conservation gradually become more evident. The benefits of modified rate structures can include greater equity, and a more balanced (less seasonal) consumption pattern.

5. Most municipal and regional water departments are staffed almost exclusively by engineers, reporting within an engineering department, who concentrate on new supply options rather than on programs requiring public involvement such as

comprehensive water conservation. (River basin management studies can have the same bias.) It is in this area that close co-operation and teamwork with an external group with different backgrounds, in this case faculty, staff and students at the University of Waterloo, can greatly facilitate consideration and implementation of a comprehensive program.

6. Economically, the two largest cities, (Cambridge and Kitchener) currently retail water using declining block rates which, by their nature, do not encourage conservation. Seminars for water managers on alternative rate-structure designs are needed.

7. Politically, at the regional level, there has been a substantial commitment to uniform average cost (i.e. low) water rates. As well, many farmers have indicated that while they privately support water conservation efforts, they do not wish to endorse such work collectively and publically. Their reasoning is that they have no assurance that the benefits in reduced water demand will be redistributed partly to them in the form of fewer water table withdrawals and not exclusively to the cities as deferred capital expenditures and lower water bills. These benefits need to be shared; it may be desirable to develop a policy to openly define the sharing.

8. There is a need for greater availability of water efficient fixtures adequately labelled as to water use. This would be helpful not only for customers, but also for plumbing inspectors administering a rebate programme.

CONCLUSIONS

Water conservation serves to reduce the strain which current demand places on the water supply system, thereby post-poning capital investment which would have been required to expand the capacity of the system. The benefits are equivalent to the price of the least costly alternative to meet these demands plus the foregone costs when sewage treatment plant loads are decreased. It should be emphasized that substantial savings in energy are also realized by local government both directly in reduced pumping costs and also indirectly in decreased production of chemicals for sewage treatment plant operation and in deferring construction of some water supply and sewage treatment facilities. Minimum benefits to householders may range from about $100 in total direct benefits to perhaps $160 including indirect benefits. These benefits can be achieved through a program including information/education, regulations/incentives for new structures, residential retrofit, pricing, wastewater reduction, water pressure reduction, elementary school curriculum, and water management planning measures. However, there are many issues which must be overcome in order to realize them. Those concerned with planning for water supply are beginning to recognize that conservation measures as part of balanced water management planning can be to everyone's advantage in postponing expensive water supply and sewage treatment projects.

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